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Adapting to change: Prioritising management for the future of the Marine Scalefish Fishery

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ABSTRACT

Marine scalefish fisheries face multiple challenges including management and sustainability pressures. These are going to be amplified by climate change. This paper reports on a project that used the Analytical Hierarchy Process (AHP) and semi-structured interviews to assess how marine scalefish fishers in South Australia, prioritise management objectives with a view to incorporating those views into structural industry reform to build the fishery's capacity to adapt in the face of these challenges. The project found that fishers, despite differences in geographical scale, fishing practice and species harvested, prioritised governance objectives most highly, and that economic and environmental objectives were prioritised as key and equally important; one could not exist without the other. Fishers prioritised social objectives the least as they expect these to follow from the economic and environmental objectives. Fishers also felt stocks had declined and that reform was urgently needed. Most fishers agreed that reform should include a reduction in licences. All fishers felt that recreational fishing was under-regulated and compromised commercial fishing opportunities. The project revealed that the capacity of fishers to adapt within the current operating environment is limited and that they will need government and other support to implement reform. For policy makers, this highlights that reform is culturally palatable but that it must include incentives and compensation for fishers to leave or stay in the industry.

1. Introduction

Worldwide, marine scalefish fisheries are facing multiple challenges including management and sustainability pressures [1]. The role played by formal institutions [2] and the need to find coordination mechanisms between public and private sectors in fisheries governance is a dominant challenge in many fisheries [3]. As Bess [4] notes the focus of management reform entails trade-offs between policies that promote economic growth and those that promote equitable distribution of the benefits of that economy. In a review of fisheries reform in New Zealand he notes that the impacts of structural reform were not clear but that there was an unintended loss of in-house experience and corporate knowledge as a result. Issues also remain in achieving effective compliance regimes for fisheries [5]. Finding ways to integrate and understand different stakeholder perceptions about fisheries management can also be problematic as shown in recent work on fisheries in Chile [6].

Many studies assert the importance of linking social and ecological dimensions. For example, a case study of mangrove fishers in Brazil demonstrated how the use of socio–ecological assessment tools can help develop guidelines that manage key fisheries issues [7]. Glass et al. [8] case study of the socio-economic considerations of the commercial weathervane scallop in Alaska also assisted in building solutions to current socio-economic issues and fostered industry dialogue. In Chile, the integration of stakeholder perceptions and preferences helped to identify conflict areas and different priorities [6]. However, a real challenge in this instance was how to incorporate intangible values into conservation objectives [6].

Examples of ecosystem based management in Norway used the ecological risk assessment for the effect of fishing methodology to try and ascertain priorities for management, achieve stakeholder involvement and develop greater transparency in management [9]. However, while ecosystem based management of fisheries is still considered an important model, it can suffer from weak spatial measures and

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integration, and a lack of functional metrics and adaptation capacity [10] and thus many other approaches are being considered. As de Jonge et al. [11] highlight, the ecosystem approach can limit the potential for integration and suggest instead that a "driver, pressure, state change, impact, response" (DPSIR) approach has greater utility in identifying industry needs and priorities. In the Pacific Island nations, socio-economic fishery indicators have helped to identify and monitor artisanal fin fisheries [12] and in California a social-ecological systems (SES) framework helped inform management of lobster fisheries [13]. A stylised bio-economic model of a multi-stock fishery was applied to study how different management objectives were affected by stock interaction and helped identify potential trade-offs between multiple objectives in stock rebuilding [14].

The emerging impacts of climate change are an added dilemma. In Australia, fisheries are facing increasing pressures, including climate change and diversification across and within coastal communities, that are creating the need for different kinds of management [15]. In this context, understanding how fishers and management agencies prioritise social and economic objectives can provide key insights into what is needed in current and future management [16]. Such objectives should be explicit, quantifiable, contain evaluation performance measures, be flexible and able to respond to changes in societal preferences as well as consider ecological restraints [17]. Fisheries approaches that seek to understand human wellbeing are needed in order to improve marine ecosystems stewardship [18]. Integral to this is understanding the context of the social licence to operate within each fishery and what is understood by it in each case [19]. Social licence to operate is increasingly being understood as the level of approval an industry has from the community to operate. In this case, the Marine Scalefish Fishery (MSF) is a very diverse fishery that is constituted by multiple types of fisher and fisheries. This has created historical conflict or division between different parties at various times and at community levels, some backlash against industry presence. As such, industry is seeking to build its credibility at local levels and find ways to consolidate its capacity to operate within different regions.

These considerations provide an important backdrop to this paper. This project sought to understand not just the management *objectives* of the fishers in the South Australian marine scale sector, but how they *prioritised* them. This is easier said than done; like many shared inshore fisheries the MSF in South Australia (SA) has sustained extensive management change over time. This, along with stock abundance and consumer demand and preferences has influenced its demographics, resulted in changes in the spread of fishing concentration and created stakeholder shifts in geographical location. Members within the MSF community are also widely dispersed both geographically and in perspective.

Specifically, the MSF is operational across the State of SA, and operates in all coastal waters of SA between the Western Australian and Victorian borders and as a result includes over 309 MSF licences and an additional 149 Southern Rock Lobster, 61 Northern Rock Lobster and 36 Lakes and Coorong Fishery licences with commercial access to marine scalefish species. However, the MSF is a limited entry fishery in that no new licences are available. Additionally, those that are current are only issued for the term of the 10 year management plan. These licences can be transferred but doing so is subject to the licence amalgamation scheme. All licence transfers are governed by the *Fisheries Management (Marine Scalefish Fisheries) Regulations 2006*. Over 60 species are taken commercially but 48% of total fishery production weight and 65% of value are comprised of the four predominant species – King George Whiting (KGW), Southern Garfish, Snapper, and Southern Calamari [20]. There are 21 gear types able to be registered on a marine scalefish licence including hook and line, longline, haul nets, mesh nets and jigs. Hand collection, handlines and rod and lines do not need registration.

This project responded to industry identified needs to develop an objective method for documenting and reconciling fisher aspirations to incorporate social and economic objectives into management of the MSF through the following objectives: (i) to identify the common and conflicting social and economic objectives for stakeholders within the MSF, (ii) to establish how they are prioritised and (iii) to provide a documented process for the ongoing monitoring and evaluation of social and economic performance within the fishery. The rest of the paper outlines the methods and results of this project.

2. Materials and methods

A mixed method approach was adopted that included: (i) document analysis, (ii) implementation of an AHP survey and (iii) conduct of a series of semi-structured interviews. These sources provided a starting point to reflect on and identify the key issues facing the fishery. This analysis was also useful as it revealed strong consistency with other data sets.

2.1. Document analysis

The process of gathering data began with the collection and analysis of a wide range of documents pertaining to the fishery. This included policy documents, results from other research projects and data on the use of social and economic indicators, amongst others (see ref list for documents used). Permission was sought and obtained to access and analyse data drawn from an economic and social indicator survey of the fishery conducted in 2014 (Econsearch, [20]. These data provided a starting point to assist in identifying key issues and confirmed the representativeness of the sample collected in the AHP survey.

2.2. Analytical Hierarchy Process (AHP)

This project used the AHP method as a conceptual framework. The AHP method is a multi-criteria prioritisation technique developed to establish a ranking of the relative importance of competing priorities [21]. AHP was used in this project to establish a ranking, for the Marine Scalefish Fishery, between social, economic and governance objectives, and between sets of objectives underlying each of these. This approach has been utilised in various contexts including fisheries in Australia [22,23] and in the Ningaloo Marine Park in Western Australia [24]. It has also been used internationally in fisheries, for example, Leung et al. [25] used AHP to evaluate fisheries management operations in Hawaii, Lee et al. [26] in South Korea, Mardle et al. [27] in the UK, and Nielsen and Mathiesen [28] used it to evaluate stakeholder preferences in relation to Sand Eel and Trout fisheries in Norway.

The survey content was developed via iterative consultation with the industry, which included feedback from the Marine Fishery Association and a pilot survey in an industry workshop. The survey was then posted in paper form to over 500 fishers in South Australia, delivered face to face in five industry workshops (where an additional 60 surveys were taken) and sent via email to an additional 200 fishers. The survey was also emailed to the Southern (160 members) and Northern (60 members) Zone Rock Lobster Associations and the Lakes and Coorong (36 members) Associations. Survey results were combined into a single data set for analysis. Out of a total of 78 responses, 40 responses (51 per cent) were usable. The rate of acceptable responses was low but within the range of those from similar AHP studies.[1] The low rate of usable responses was due to the constraints of the AHP methodology. Specifically, each survey response must be sufficiently internally consistent[2] in order to be accepted into the analysis.

[1] 87 per cent in Pascoe et al. [22], 100 per cent in Pascoe et al. [23], 35 per cent in Mardle et al. [27] but more were allowed through under an additional consistency rule, and 74 per cent with an inconsistency threshold of 0.2 in Himes (30).

[2] An inconsistency ratio of less than 0.1 for any level and branch was selected to indicate sufficient internal consistency. This is the suggested threshold from the author of the method (21) and has been used in multiple fisheries studies (27; 22;23). One study of

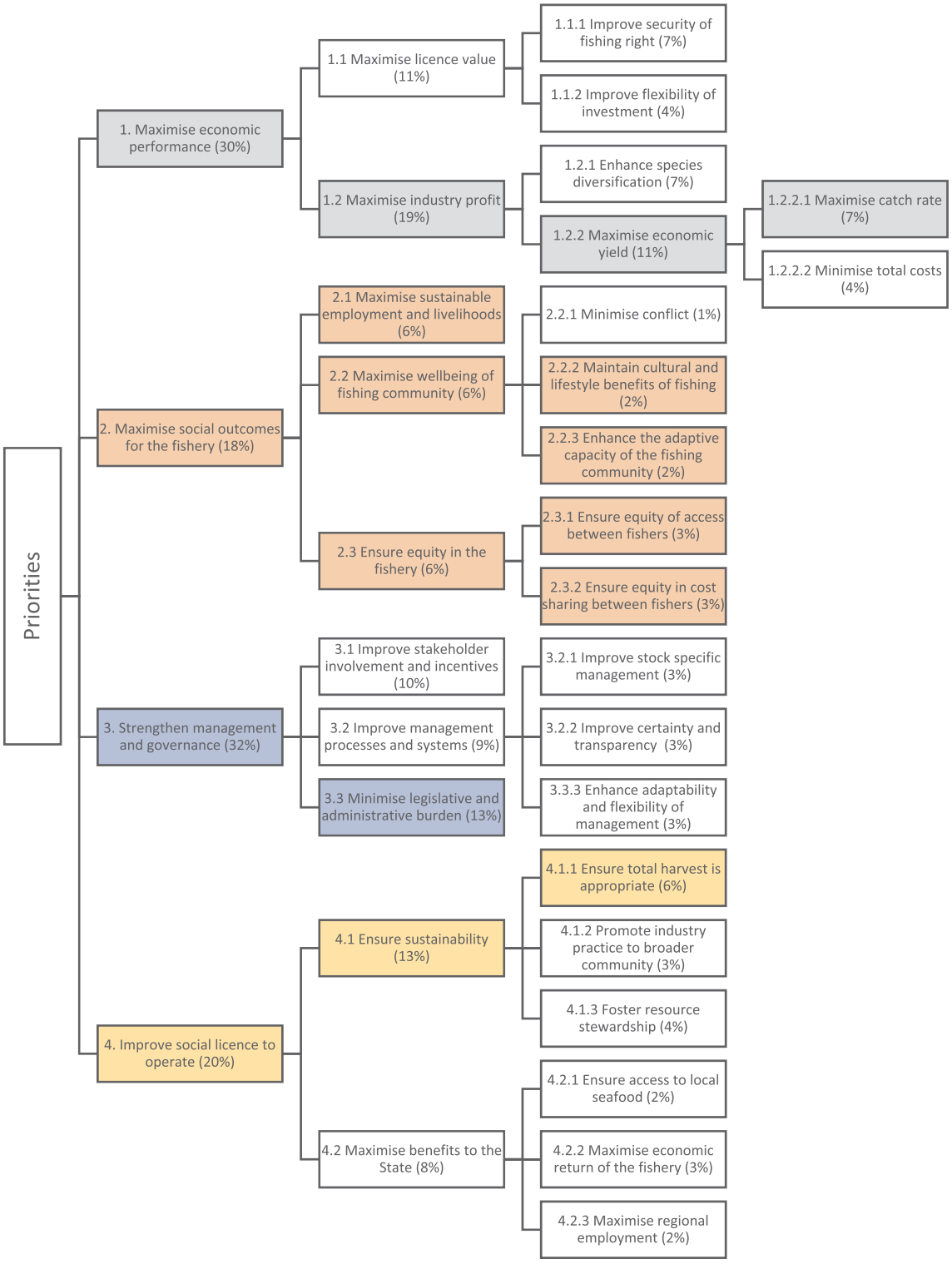
Priorities
1. Maximise economic performance (30%)
1.1 Maximise licence value (11%)
1.1.1 Improve security of fishing right (7%)
1.1.2 Improve flexibility of investment (4%)
1.2 Maximise industry profit (19%)
1.2.1 Enhance species diversification (7%)
1.2.2 Maximise economic yield (11%)
1.2.2.1 Maximise catch rate (7%)
1.2.2.2 Minimise total costs (4%)
2. Maximise social outcomes for the fishery (18%)
2.1 Maximise sustainable employment and livelihoods (6%)
2.2 Maximise wellbeing of fishing community (6%)
2.2.1 Minimise conflict (1%)
2.2.2 Maintain cultural and lifestyle benefits of fishing (2%)
2.2.3 Enhance the adaptive capacity of the fishing community (2%)
2.3 Ensure equity in the fishery (6%)
2.3.1 Ensure equity of access between fishers (3%)
2.3.2 Ensure equity in cost sharing between fishers (3%)
3. Strengthen management and governance (32%)
3.1 Improve stakeholder involvement and incentives (10%)
3.2 Improve management processes and systems (9%)
3.2.1 Improve stock specific management (3%)
3.2.2 Improve certainty and transparency (3%)
3.3 Minimise legislative and administrative burden (13%)
3.3.3 Enhance adaptability and flexibility of management (3%)
4. Improve social licence to operate (20%)
4.1 Ensure sustainability (13%)
4.1.1 Ensure total harvest is appropriate (6%)
4.1.2 Promote industry practice to broader community (3%)
4.1.3 Foster resource stewardship (4%)
4.2 Maximise benefits to the State (8%)
4.2.1 Ensure access to local seafood (2%)
4.2.2 Maximise economic return of the fishery (3%)
4.2.3 Maximise regional employment (2%)

Fig. 1. AHP weighted hierarchy of priorities for the whole sample (AHP Survey, 2016).

2.3. Semi-structured interviews

A follow up round of interviews was conducted to maximise participation, complement the survey data and deepen the analysis. To recruit interview participants, an email was sent to 55 fishers whose names were obtained from survey responses or who had volunteered for an interview. Follow up phone calls were then made to those who responded in the affirmative. Altogether 23 interviews were conducted with representatives from all parts of the State. Fishers were asked semi-structured questions around: (i) what management objectives mattered to them, (ii) which ones they would prioritise, (iii) perceptions of management, (iv) constraints to the fishery and management and (v)

(*footnote continued*)
fisheries used a less restrictive threshold of 0.2 (30) and Pascoe et al. [22] allowed responses with an inconsistency between 0.1 and 0.15 through under certain circumstances. In this study however, a conservative threshold of 0.1 was chosen in favour of allowing more responses through to preserve robustness of the results.

what models of management they would like to see into the future. Data collection via interview continued until 'information saturation' was achieved. This is the point at which it becomes clear that no new information will be found, and the researcher can conclude with confidence that the research has achieved its goals. It is at this point that information collection can cease [29]. The interviews revealed a range of other perceptions and themes surrounding the issue and provided further insights and richer data on the social and economic context of marine scale fisheries in the State.

Thematic analysis was used to code and categorise the key results from these interviews. Thematic analysis permits the identifying of patterned meaning across a data set that provides an answer to the question being investigated [29]. It is a flexible method that can be used across methodologies and questions as it assists in understanding people's perceptions, feelings, values and experiences. An inductive approach to the analysis was taken, with coding and theme development indicated by the data, rather than making assumptions prior to beginning. Analysis occurred in five stages: (i) familiarisation with the data, (ii) searching for themes, (iii) coding, (iv) reviewing and amending themes, and (v) writing up. Although additional details were gathered via the interviews, it is significant that the final analysis revealed that the dominant themes are consistent with those found in the AHP survey. In this analysis, while there were obvious variations due to data type, there is clear consistency around core themes.

2.4. Triangulation

Triangulation of the various data sets ensured validity of the findings as the results from (i) documents, (ii) the AHP survey and (iii) interviews presented similar patterns and consistent findings. Triangulation is the technique adopted within the social science domain to ensure validation of data via cross verification from two or more sources [30]. It stipulates the employment and combination of a number of research methods to investigate the same phenomenon. This creates added confidence in the results [31]. Three different forms of triangulation were utilised: (i) method triangulation, (ii) investigator triangulation and (iii) data triangulation.

Overall, the use of multiple techniques ensured the documentation of all the different perspectives around the development and prioritisation of social and economic indicators for the MSF in SA.

3. Results

Overall, synthesis of the data sources indicated that all fishers felt stocks had declined and that reform was urgently needed. Analysis showed that fishers, despite differences in geographical scale, fishing practice and species harvested, prioritised governance objectives most highly. Further, economic and environmental objectives were prioritised as key and equally important; one could not exist without the other. Fishers prioritised social objectives least as they expect these to follow from reaching the economic and environmental objectives. Most fishers agreed that reform should include a reduction in licences. All fishers felt that recreational fishing was under-regulated and compromised commercial fishing opportunities. The project revealed that the capacity of the fishers to adapt within the current operating environment is limited and that they will need government and other support to implement reform.

3.1. AHP analysis results

This section presents the results of the AHP survey. The results are presented for the whole sample, then by region, by target species, and by method.

3.2. Whole sample

The weighted hierarchy for the whole sample is presented in Fig. 1. The percentage in brackets for each priority is respondents' average importance placed on that priority. Comparing the weights across the first level of the hierarchy shows that the most important high level priority for the whole sample is *'Strengthen management and governance'* (32 per cent), followed by *'Maximise economic performance'* (30 per cent), *'Improve social licence to operate'* (20 per cent), and *'Maximise social outcomes for the fishery'* (18 per cent). To tease out the primary issues underlying each of the high level priorities, a set of priorities has been shaded on each branch in Fig. 1 by moving from left to right and shading the priority with the greatest weighting on each level of each branch. In order of level of importance of high-level priorities, Fig. 1 shows the priorities underlying each are:

1. Strengthen management and governance – by minimising legislative and administrative burden.
2. Maximise economic performance – by maximising catch rate and subsequently, maximising economic yield and industry profit.
3. Improve social licence to operate – by ensuring total catch for the marine scale fishery is appropriate, subsequently ensuring the industry is sustainable.
4. Maximise social outcomes for the fishery – through a range of priorities including sustainable employment and livelihoods, community wellbeing and equity in the fishery.

3.2.1. Disaggregation by region, species and method

Weightings for the hierarchy are presented in Table 1 for each group in the sample. Comparing the weightings between groups reveals the common and conflicting priorities across the fishery. Each column in the table presents weightings equivalent to those presented on the hierarchy in Fig. 1. The priorities for each group have been numbered using the same method as was used to shade priorities in Fig. 1 in order to reveal the priorities underlying the high-level priorities.

The same priorities underlie the *'Maximise economic performance'* priority for all groups other than net and line fishers and those who target Snapper. Under this priority, net and line fishers place more importance on *'Maximising licence value'* through *'Improving security of fishing right'* rather than *'Maximising industry profit'* through the catch rate. Those who target Snapper are similar to other fishers except they also place importance on *'Enhancing species diversification'* as a means to *'Maximising industry profit'*.

A wide range of priorities underlie the '*Maximise social outcomes for the fishery'* priority for the aggregated sample but the disaggregation shows that the underlying priorities conflict across the fishery. WC (West Coast region) fishers place more importance on *'Sustainable employment and livelihoods*', while GSVKISE (Gulf St. Vincent, Kangaroo Island and South East region) fishers and those who target Snapper or Squid place more importance on *'Ensuring equity in the fishery'*. Net and line fishers place more importance on the *'Wellbeing of the fishing community'*.

The disaggregation shows that common priorities underlie the *'Strengthen management and governance'* and *'Improve social licence to operate'* priorities across the fishery. The only exception is that, for GSVKISE fishers, *'Strengthening management and governance'* means *'Improving stakeholder involvement and incentives'* rather than *'Minimising legislative and administrative burden'*, as it does for the rest of the fishery.

Table 1 also shows the sample size for each group in each disaggregation. The groups in the method and region disaggregations are mutually exclusive. The groups in the species disaggregation are not mutually exclusive as they were assigned to multiple groups if they targeted multiple main species, but their relative priorities can be interpreted similarly to the other disaggregations. A more detailed discussion of disaggregated AHP results can be found in the project report [32].

Table 1
AHP weighted hierarchy of priorities, disaggregation (source AHP Survey).

Sample size - n=	Whole Sample		Region								Method				Target Species							
			SGCB		WC		GSVKISE				Line Only		Net + Line		KGW		Snapper		Squid		Garfish	
		40		*13*		*18*		*9*				*35*		*5*		*29*		*18*		*22*		*9*
1. Maximise economic performance	①	30%	①	34%	①	24%	①	36%			①	29%	①	38%	①	28%	①	27%	①	28%	①	33%
1.1 Maximise licence value		11%		14%		7%		17%				10%	②	22%		10%		11%		9%		11%
1.1.1 Improve security of fishing right		7%		9%		4%		12%				6%	③	19%		5%		6%		5%		8%
1.1.2 Improve flexibility of investment		4%		5%		3%		5%				4%		2%		5%		5%		4%		4%
1.2 Maximise industry profit	②	19%	②	20%	②	17%	②	19%			②	19%		17%	②	19%	②	16%	②	19%	②	22%
1.2.1 Enhance species diversification		7%		7%		8%		7%				7%		7%		8%	③	8%		8%		10%
1.2.2 Maximise economic yield	③	11%	③	13%	③	10%	③	12%			③	11%		10%	③	11%	③	8%	③	11%	③	12%
1.2.2.1 Maximise catch rate	④	7%	④	7%	④	6%	④	9%			④	7%		7%	④	6%	④	4%	④	6%	④	8%
1.2.2.2 Minimise total costs		4%	④	7%		4%		3%				4%		3%		5%	④	4%		5%		4%
2. Maximise social outcomes for the fishery	①	18%	①	15%	①	18%	①	22%			①	18%	①	17%	①	18%	①	17%	①	16%	①	15%
2.1 Maximise sustainable employment and livelihoods	②	6%		4%	②	7%		7%			②	6%		5%	②	6%		6%		4%	②	5%
2.2 Maximise wellbeing of fishing community	②	6%	②	5%		6%		7%			②	6%	②	8%	②	6%		4%		5%	②	5%
2.2.1 Minimise conflict		1%		1%		1%		2%				1%	③	3%		1%		1%		1%		1%
2.2.2 Maintain cultural and lifestyle benefits of fishing	③	2%	③	3%		2%		2%			③	2%		2%	③	2%		1%		2%		1%
2.2.3 Enhance the adaptive capacity of the fishing community	③	2%		2%		3%		3%			③	2%	③	3%	③	2%		2%		2%	③	3%
2.3 Ensure equity in the fishery	②	6%	②	5%		5%	②	8%			②	6%		4%	②	6%	②	7%	②	6%		4%
2.3.1 Ensure equity of access between fishers	③	3%	③	3%		3%	③	4%			③	3%		2%	③	3%	③	3%	③	3%		2%
2.3.2 Ensure equity in cost sharing between fishers	③	3%		2%		2%	③	4%			③	3%		2%	③	3%	③	3%	③	3%		2%
3. Strengthen management and governance	①	32%	①	31%	①	35%	①	28%			①	34%	①	23%	①	34%	①	35%	①	32%	①	32%
3.1 Improve stakeholder involvement and incentives		10%		9%		11%	②	11%				11%		7%		10%		9%		10%		11%
3.2 Improve management processes and systems		9%		8%		9%		10%				9%		7%		9%		9%		11%		10%
3.2.1 Improve stock specific management		3%		3%		3%		3%				3%		2%		3%		3%		3%		3%
3.2.2 Improve certainty and transparency		3%		3%		3%		4%				3%		2%		3%		3%		4%		4%
3.3.3 Enhance adaptability and flexibility of management		3%		2%		3%		3%				3%		3%		3%		3%		3%		3%
3.3 Minimise legislative and administrative burden	②	13%	②	14%	②	15%		7%			②	14%	②	9%	②	14%	②	17%	②	12%	②	12%
4. Improve social licence to operate	①	20%	①	21%	①	22%	①	14%			①	20%	①	22%	①	20%	①	20%	①	24%	①	20%
4.1 Ensure sustainability	②	13%	②	15%	②	13%	②	9%			②	12%	②	13%	②	12%	②	12%	②	14%	②	13%
4.1.1 Ensure total harvest is appropriate	③	6%	③	8%	③	6%	③	5%			③	6%	③	7%	③	7%	③	6%	③	7%	③	7%
4.1.2 Promote industry practice to broader community		3%		4%		2%		2%				3%		3%		2%		2%		3%		2%
4.1.3 Foster resource stewardship		4%		3%		5%		2%				4%		3%		4%		3%		4%		3%
4.2 Maximise benefits to the State		8%		6%		10%		5%				7%		9%		8%		8%		9%		7%
4.2.1 Ensure access to local seafood		2%		2%		2%		2%				2%		3%		2%		2%		3%		2%
4.2.2 Maximise economic return of the fishery		3%		2%		4%		2%				3%		3%		3%		3%		4%		3%
4.2.3 Maximise regional employment		2%		2%		3%		2%				2%		3%		2%		3%		3%		2%

3.2.2. Group coherence

The level of coherence for each group gives an indication of how closely aligned each respondent's responses are to the other respondents' in the same group [33, 34]. A coherence value of 1 shows perfect coherence where each respondent gave an identical response. The lower a coherence value, the less alike the responses within the group are. The whole sample has a coherence value of 0.90 at the highest level, 0.84 at the middle level and 0.80 at the lowest level. The sequential decrease occurs as the comparisons become more complex on lower levels of the hierarchy. Fishers who primarily target Garfish were the group with the lowest coherence value (0.74), indicating the most conflicting priorities. WC fishers had the highest coherence (0.93), indicating the least conflicting priorities.

3.3. Summary of interviews

As noted in the method section we also undertook a series of semi-structured interviews. The interview questions were in line with the AHP survey, and sought to understand fisher's objectives and how they were prioritised. As with the AHP results (see Fig. 1) we found that fishers expressed an overriding concern about the need for governance reform, and also that stock numbers were too low to be sustained within current regulations. Environmental objectives, in terms of achieving adequate stock numbers, were thus weighted similarly to economic ones, with social objectives being seen as an automatic 'flow on' from these. We provide a synopsis of some of these themes below and use indicative quotes to showcase how these views were expressed.

3.3.1. Governance reform is a vital first priority

Overall fishers consistently reiterated the need to address issues with governance, specifically asserting the need for the State department of Primary Industries and Resources (PIRSA) to enact reform and *hear* industry voice;

> "We need responsible government and PIRSA and SARDI to have a part in management. But they need to listen to industry a lot more´(MSF 7).

> "I truly believe the fishery has been significantly mismanaged for several years now. It has been allowed to deplete to concerning levels through both ignorance, communication failures and not taking note of serious matters raised by fishers for many years. For example, we have been pleading to implement a quota on snapper but was continually rejected. Now in only recent times they are addressing the problem. I hope it is not too late (MSF 28).

3.3.2. Constraints to management

On the topic of governance, fishers also discussed a number of historical impediments that in their view had caused current management issues and were likely to impinge on future management. One of these, asserted as a key block to management, was the establishment of Marine Protected Areas (MPA), which were perceived to inhibit access and capacity for stock replenishment. One example frequently given was that four commercial fishers near Port Wakefield have stopped operating due to the nearby MPA:

> "Look, since the marine parks have been in, seriously, we have lost a lot, access, stock, money. It's a joke" (MSF 24).

> "Marine Protected Areas, now that's an example of a big big mistake" (MSF 15).

Another perceived block to effective governance was the issue of recreational activity and take:

> "Recreational fishers impact business more than professional fishers, we're outnumbered 30 to 1" (MSF 1).

> "Reco fishers push me off fish more and more every year. This means I lose money! 10 years ago it was rare to see reco boats. Today everywhere!" (MSF 21).

A number of fishers also raised concerns over leasing issues, arguing that the shift to leasing licences had meant that non-fishers, with little experience, were beginning to get control of the industry in ways that were disadvantageous to its long-term future. The following quote is illustrative:

> "I have been a commercial fisherman for nearly 30 years now. In that time, I have seen a huge change in the MSF and unfortunately not for the better. … Fish stocks seemed to be better and it was not uncommon to work a patch to yourself. … now everywhere I go I see other commercial fishermen. Everyone who is licenced has the right to fish where ever that they choose but some of these so-called fishermen have no scruples or manners and that has diminished fish stocks [and is] causing huge angst in our industry. I believe to sort this mess out is quite a simple matter…We all know we need to reduce licences. Simple plan, buy out all licences being leased that will reduce pressure on stocks of fish [and] add value to licences to the people who actually own them." (MSF 27).

These concerns were echoed across the board and generated some (cynical) pessimism in relation to the future of the industry:

> "I can tell you now, in 5 years you guys will not have a job because you won't have anyone bar people leasing and pro fishers who are only dodging taxes through other businesses with fishing" (MSF 6).

Finally, fishers suggested a number of strategies for governance reform. The reduction of licences or quota was advanced most commonly as the key management idea, but zoning, charging recreational fishers fees, and the introduction of Total Allowable Catch (TAC) were other ideas:

> "Introduce zoning (eg. like abalone and rock lobster), introduce TAC and individual (transferable) quota, scrap antiquated amalgamation scheme (its passed the used by date)" (MSF 5).

> "Just charge recreational's $100 a year. Our fees would be about a quarter of now" (MSF 19).

Other suggestions included imposing greater regulation on the recreational sector, and a cap on effort, reducing the number of licences, to implement scale based, or geographically tailored fish management, to establish zoning arrangements such as in Abalone and Rock Lobster, and to instigate processes of licence buy-back but at reasonable levels of compensation. Interestingly, co-management was generally rejected as a forward pathway for two reasons: (i) most fishers, although agreeing to the need for management, did not agree they should have to make the decisions about how to do that and (ii) most felt that government, specifically PIRSA should make those decisions.

3.3.3. Prioritisation of other objectives

Outside of governance reform, when asked to identify and define the key issues confronting the fishery in line with economic, environmental and social categories, fishers consistently reiterated an overriding concern with stock numbers:

> "Well it's the stock. So much less now than there was. That's the real problem right there, no point talking about money if there's no fish to sell. What we need is regulations to build the stocks" (MSF 21).

When asked to choose between social and economic objectives, the latter were prioritised agreeing with the high-level AHP result in Fig. 1. Being able to make enough money, being able to sell at a good price, and being able to cover costs for their fundamental needs was highlighted as of utmost importance. Fishers then noted that if the economic objectives were prioritised that social advantages would naturally follow: social dimensions were considered really important to well-being. Fishers emphasised that not only was being part of a community important, but that they also played a crucial role in *making* a community, particularly in small regional areas. A number of fishers reflected on how their towns and regions had contracted and lost social capital once fishers left the area. One fisher detailed the decline in small towns in the Yorke Peninsula based on a reduction of numbers or migration of fishers.

> "Look, without these guys, these fishing families, there would be no schools, no footie clubs, no shops…lose the fishers, lose the town…" (MSF 17).

> "Open your ears and listen to the guys who have seen the catches fall to a stage where it will not return unless someone makes hard decisions on the future. A good lifestyle say the new fishers…well having a lifestyle is no good when you are broke. (MSF 7).

4. Discussion and conclusions

The findings above reveal a number of key considerations which have implications for ensuring positive outcomes for future reform of the fishery. Firstly, despite the clear and sometimes conflict-driven diversity amongst the fishers, there was overall strong agreement about the state of the fishery; the fish stocks are perceived to be low and it was unanimously asserted that the industry has retracted significantly in the last twenty years. Fish stocks are also likely to be under increasing pressure due to climate change, so overall the need for governance reform was the highest management priority for the fishery and urgently needed.

The results also show that *both* economic and environmental objectives were prioritised as of key importance, but crucially they were seen as *equally* important on the assumption that you could not have one without the other. Social objectives were of the lowest priority - a result that was contrary to initial expectations. Importantly, while it is not the case that fishers are unconcerned by social issues, they do see them as being addressed only as a consequence of proper management of environmental and economic issues.

These results are consistent with findings by Mardle et al. [27] and Pascoe et al. [23] who found that fishers rated sustainability of stocks and the maximisation of economic benefits to fishers as key objectives. However, the findings of Mardle et al. [27] in UK fisheries, Pascoe et al. [23] in Australian Commonwealth managed fisheries and Leung et al. [25] in Hawaii, all show that administrative and management groups place a much higher importance on environmental objectives than fishers do. It is therefore worth considering whether such a disparity between fisher and management goals might be confounding attempts

to manage the MSF effectively. For this reason, future studies on the prioritisation of objectives should not only analyse fisher objectives but also those of other stakeholders, particularly administrative bodies, recreational fishers and residents in communities affected by fishing. As Mardle et al. [27, p. 9] point out, 'different groups place different importance on the individual objectives and therefore judge performance of the policy against their own individual set of priorities'.

The implications of these findings for the MSF are varied. At one level, this project yielded key information about fisher perspectives and industry needs. Yet what the project really reveals is that the capacity of the fishers to adapt to current changes is limited and that they need government and other support to implement reform. Gutiérrez and Morgan [3] have shown that some fisheries in the US and UK have been able to implement non-state market-driven governance by teaming up with environmental non-governmental organisations and other sectoral actors. However, this case study indicates that fisheries such as the MSF may be unlikely to initiate such innovative governance. This is because there is a strong perception that government should be responsible for the management of the fishery. A strong desire to minimise fisher management burdens and a lack of diverse social networks in the MSF could prohibit the advancement of new ideas and approaches to governance [36]. Although this suggests a propensity in the MSF to await government actions to rectify worsening stock levels and economic conditions, there may be opportunities for coordination between public and private governance regimes that are yet to be explored.

The project also highlighted the very strict parameters within which fishers are engaging with the question of their activity: adapting to change for the MSF means focusing on governance reform that will enhance fish stocks and livelihoods in the short to medium term. However, the question of climate change impacts and how to adapt to them are not part of the wider discourse about management. This suggests that there needs to be greater collaboration between government, scientists and the fishers to develop tailored, and geographically specific management reform that will build stocks and also the social-ecological resilience of the fishery to climate change and other mounting challenges. Further, such a collaboration could deliberately engage with the issue of recreational harvest. There are clearly opportunities for innovative management between the commercial and recreational sectors of this fishery.

This project reveals some key challenges facing fisheries the world over. These tensions: between commercial and recreational fishers, between government and fishing institutions, between harvest and stock levels and the disruptions caused by climate change are endemic. However, this project shows that in creating the entry points for fishers to express their views on future management and reform, valuable insights can be gained, productive ideas about appropriate forms of management can be documented, and a willingness to build reform enhanced.

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Appendix A

This Appendix presents a reproduction of the survey instrument used for data collection. It is necessarily different to the actual instrument used by respondents as that was a spreadsheet with dropdown boxes and sliders for coding responses. It also gave respondents immediate feedback on the consistency of their response.

Questionnaire

Participation and Confidentiality

Participation in this study is voluntary. You are free to withdraw from this study at any time (i.e. just do not return the survey). Only completed surveys will be used in the analysis. Individual data will not be identifiable, and all information collected in this study will be confidential. Information on your identity is only collected in case there is a need to get back to you to seek clarification about your responses. The data will only be seen by members of our research team and will be stored in a secure area that is not accessible to any individuals other than the research team. Your information will only be used for research purposes.

Note that returning the completed survey indicates your consent to participate.

Thank you for your valuable input to this important project.

Personal Details		
Name		
Age		
Address		
Licence Number		
Licence Class (select one)	◯ Amalgamated ◯ Single ◯ Restricted (b)	
Interest (select one)	◯ Owner ◯ Lessee ◯ Master	◯ Partner ◯ Deckhand
Main gear type used (select one)	◯ Handline ◯ Longline ◯ Net	◯ Other ◯ All

Fishing operations

Primary Fishing Region (select one)	◯ West Coast ◯ Coffin Bay / Spencer Gulf ◯ Gulf St Vincent ◯ Kangaroo Island / South East	
Primary port/town		
Secondary Fishing Region (select all that apply)	◯ West Coast ◯ Coffin Bay / Spencer Gulf ◯ Gulf St Vincent ◯ Kangaroo Island / South East ◯ None	
Years MSF Fishing (select one)	◯ 0–5 ◯ 5–10 ◯ 10–15	◯ 15–20 ◯ 20–25 ◯ 25+
Nights away from home fishing (select one)	◯ 0–5 ◯ 5–10 ◯ 10–15	◯ 15–20 ◯ 20–25 ◯ 25+
Current Target Species (select all that apply)	◯ KGW ◯ Snapper ◯ Squid	◯ Garfish ◯ Other
Future Target Species (select all that apply)	◯ No change ◯ KGW ◯ Snapper ◯ Squid	◯ Garfish ◯ Other ◯ Unsure

Future

What is your key concern for the fisheries future? (select all that apply)	◯ Biological sustainability ◯ Economic sustainability ◯ Social sustainability ◯ Other:_____
Does the management of fishery need to change to have a viable future? (select one)	◯ Yes, significant change required ◯ Yes, some minor changes ◯ No ◯ Unsure
Would you encourage, your children or young people to invest in the fishery? (select one)	◯ Yes, definitely ◯ Yes, with some reservation ◯ No ◯ Unsure
What is the ideal number of licence in your region?	
What is the ideal number of licences across the State?	
Would you support a co-contribution (Ind/Gov) fund to adjust licence numbers? (select one)	◯ Yes ◯ No ◯ Unsure
Does recreational fishing impact you more than other professional fishers? (select one)	◯ Yes ◯ No ◯ Unsure
Would you have answered these question the same 10 years ago? (select one)	◯ Yes ◯ No ◯ Unsure

High Level Objectives

Coding (not visible)	*−8 −7 −6 −5 −4 −3 −2 −1 0 1 2 3 4 5 6 7 8*					
	Most Important	More important	Equally important	More important	Most Important	
1.0 Maximise economic perfor-mance						2.0 Maximise social outcomes for the fishery

1.0 Maximise economic performance	3.0 Strengthen management and governance
1.0 Maximise economic performance	4.0 Improve social licence to operate
2.0 Maximise social outcomes for the fishery	3.0 Strengthen management and governance
2.0 Maximise social outcomes for the fishery	4.0 Improve social licence to operate
3.0 Strengthen management and governance	4.0 Improve social licence to operate

Maximising the Economic Performance

Coding (not visible)	*−8 −7 −6 −5 −4 −3 −2 −1 0 1 2 3 4 5 6 7 8*					
	Most Important	More important	Equally important	More important	Most Important	
1.0 Maximise licence value						2.0 Maximise industry profit

Maximising Licence Value

Coding (not visible)	*−8 −7 −6 −5 −4 −3 −2 −1 0 1 2 3 4 5 6 7 8*					
	Most Important	More important	Equally important	More important	Most Important	
1.0 Improve security of fishing right						2.0 Improve flexibility of investment

Maximising Industry Profit

Coding (not visible)	*−8 −7 −6 −5 −4 −3 −2 −1 0 1 2 3 4 5 6 7 8*					
	Most Important	More important	Equally important	More important	Most Important	
1.0 Enhance species diversification						2.0 Maximise economic yield

Maximising Economic Yield

Coding (not visible)	*−8 −7 −6 −5 −4 −3 −2 −1 0 1 2 3 4 5 6 7 8*					
	Most Important	More important	Equally important	More important	Most Important	
1.0 Maximise catch rates						2.0 Minimise total annual costs of fishing

Maximising Social Outcomes

Coding (not visible)	*−8 −7 −6 −5 −4 −3 −2 −1 0 1 2 3 4 5 6 7 8*					
	Most Important	More important	Equally important	More important	Most Important	
1.0 Maximise sustainable employment and livelihoods						2.0 Maximise wellbeing of fishing community
1.0 Maximise sustainable employment and livelihoods						3.0 Ensure equity in the fishery
2.0 Maximise wellbeing of fishing community						3.0 Ensure equity in the fishery

Maximising Wellbeing of Fishing Community

Coding (not visible)	*−8 −7 −6 −5 −4 −3 −2 −1 0 1 2 3 4 5 6 7 8*					
	Most Important	More important	Equally important	More important	Most Important	
1.0 Minimise conflict						2.0 Maximise cultural and lifestyle benefits of fishing
1.0 Minimise conflict						3.0 Enhance the adaptive capacity of the fishing community
2.0 Maximise cultural and lifestyle benefits of fishing						3.0 Enhance the adaptive capacity of the fishing community

Maximising Equity in the Fishery

	−8 −7 −6 −5 −4 −3 −2 −1 0 1 2 3 4 5 6 7 8					
	Most Important	More important	Equally important	More important	Most Important	
1.0 Ensure equity of access						2.0 Ensure equity in cost sharing

Strengthen Management and Governance

Coding (not visible)	*−8 −7 −6 −5 −4 −3 −2 −1 0 1 2 3 4 5 6 7 8*					
	Most Important	More important	Equally important	More important	Most Important	
1.0 Improve stakeholder involvement and incentives						2.0 Improve management processes and systems
1.0 Improve stakeholder involvement and incentives						3.0 Minimise legislative and administrative burden
2.0 Improve management processes and systems						3.0 Minimise legislative and administrative burden

Improve Management Processes and Systems

Coding (not visible)	*−8 −7 −6 −5 −4 −3 −2 −1 0 1 2 3 4 5 6 7 8*					
	Most Important	More important	Equally important	More important	Most Important	
1.0 Improve stock specific management						2.0 Improve certainty and transparency
1.0 Improve stock specific management						3.0 Enhance adaptability and flexibility of management
2.0 Improve certainty and transparency						3.0 Enhance adaptability and flexibility of management

Improve social licence to operate

Coding (not visible)	*−8 −7 −6 −5 −4 −3 −2 −1 0 1 2 3 4 5 6 7 8*					
	Most Important	More important	Equally important	More important	Most Important	
1.0 Ensure sustainability						2.0 Maximise benefits to the State

Ensure sustainability

Coding (not visible)	*−8 −7 −6 −5 −4 −3 −2 −1 0 1 2 3 4 5 6 7 8*					
	Most Important	More important	Equally important	More important	Most Important	
1.0 Ensure total harvest is appropriate						2.0 Promote industry practice to broader community
1.0 Ensure total harvest is appropriate						3.0 Foster resource stewardship
2.0 Promote industry practice to broader community						3.0 Foster resource stewardship

Maximise benefits to the State

Coding (not visible)	*−8 −7 −6 −5 −4 −3 −2 −1 0 1 2 3 4 5 6 7 8*					
	Most Important	More important	Equally important	More important	Most Important	
1.0 Ensure access to local fresh seafood						2.0 Maximise economic return from the fishery
1.0 Ensure access to local fresh seafood						3.0 Maximise regional employment, direct and indirect
2.0 Maximise economic return from the fishery						3.0 Maximise regional employment, direct and indirect

Final steps:

1. The table and diagrams (presented in the spreadsheet) summarize objective weightings based on the responses that you have just given. Please review these weightings and return to any previous pages to change your responses if required.
2. Please also check that no inconsistency ratios (presented in the spreadsheet) exceed 10%. If so, please return to the relevant question and amend your responses accordingly.
3. If you believe that any of the objectives that you have been asked to consider are not relevant to your fishery/jurisdiction, please list them in the space below.

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